USDA United States Department of Agriculture

Pest Alert

Emerald Ash Borer

Emerald ash borer (*Agrilus planipennis* Fairmaire (Coleoptera: Buprestidae)) is a wood-boring beetle from Asia that was identified in July 2002 as the cause of widespread ash tree (*Fraxinus* spp.) decline and mortality in southeastern Michigan and adjacent parts of Ontario, Canada. Larval feeding between the bark and sapwood disrupts transport of nutrients and water in a tree, causing dieback of the branches and eventually death of the tree. Tens of millions of ash trees in forest, rural, and urban areas have already been killed, and many more are rapidly declining from this pest.

Emerald ash borer (EAB) infestations have since been confirmed in all or parts of 24 States and the Canadian Provinces of Ontario and Quebec. While most of the detections have occurred in eastern North America, the insect has been found as far west as Colorado. New EAB detections in other areas are likely as surveys continue (see www.emeraldashborer.info/ for periodic updates). Evidence indicates that EAB is often established in an area for several years before it is detected.

The broad distribution of this pest in the United States and Canada is primarily due to commerce and the inadvertent transport of infested ash firewood, unprocessed logs, nursery stock, and other ash commodities. Federal and State quarantines now regulate the movement of these products from the infested areas to areas not known to have EAB.

Identification

Adult beetles (Fig. 1) are slender, elongate, and 7.5 to 13.5 mm (0.3 to 0.5 in.) long. They generally have dark, metallic emerald green wing covers and bodies that are bronze, golden, or reddish green. The dorsal side of the abdomen is metallic purplish red and can be seen when the wings are spread (Fig. 2). Males are smaller than females and have fine hairs, which the females lack, on the ventral side of the thorax. The prothorax, the segment behind the head and to which the first pair of legs is attached, is slightly wider than the head and the same width as the wing covers. Adult EAB are generally larger and brighter green than the native North American *Agrilus* species.

Larvae reach a length of 26 to 32 mm (1.0 to 1.3 in.), are white to cream colored, and dorso-ventrally flattened (Fig. 3). The brown head is mostly retracted into the prothorax, and only the mouthparts are visible. The abdomen has 10 segments, and the last segment has a pair of brown, pincer-like appendages.

Figure 1. Adult emerald ash borer

Figure 2. Purplish red abdomen on adult beetle.

Figure 3. (Bottom to top) Second, third, and fourth stage larvae.

Figure 4. Gallery of an emerald ash borer larva

Biology

EAB generally has a 1-year life cycle. In the upper Midwest, adult beetles begin emerging in May or early June. Beetle activity peaks between mid June and early July, and continues into August. Adults probably live for about 3 weeks, although some have survived for more than 6 weeks in the laboratory. Beetles generally are most active during the day, particularly when it is warm and sunny, and move to protected locations in bark crevices or cling to foliage during inclement weather.

Adult beetles feed on ash foliage, usually leaving small, irregularly shaped patches along the leaf margins, causing negligible damage to the tree. At least a few days of feeding are needed before beetles mate, and an additional 1 to 2 weeks of feeding may be needed before females begin laying eggs. Females can mate multiple times. Each female probably lays 30 to 60 eggs during an average lifespan, but a long-lived female may lay more than 200 eggs. Eggs are deposited individually in bark crevices or under bark flaps on the trunk or branches, and soon darken to a reddish brown. Eggs hatch in 7 to 10 days.

Newly hatched larvae chew through the bark and into the phloem and cambial region of the tree. Larvae feed on phloem for several weeks, creating serpentine (S-shaped) galleries packed with fine sawdust-like frass. As a larva grows, its gallery becomes progressively wider (Fig. 4), often etching the outer sapwood. The length of the gallery generally ranges from 10 to 50 cm (about 4 to 20 in.). Feeding is usually completed in autumn.

Prepupal larvae overwinter in shallow chambers, roughly 1 cm (0.4 in.) deep, excavated in the outer sapwood or in the bark on thick-barked trees. Pupation begins in late April or May. Newly eclosed adults often remain in the pupal chamber or bark for 1 to 2 weeks before emerging head-first through a D-shaped exit hole that is 3 to 4 mm (0.1 to 0.2 in.) in diameter (Fig. 5).

Figure 5. D-shaped hole where an adult beetle emerged.

Two-year development of EAB larvae is typical in newly infested ash trees that are relatively healthy. In these trees, many larvae overwinter as early instars, feed a second summer, overwinter as prepupae, and emerge the following summer. However, in trees stressed by physical injury, high EAB densities, or other problems, many or all larvae may develop in a single year. Whether a 2-year life cycle will occur in warmer southern States is not yet known.

Distribution and Hosts

EAB is native to Asia and is found in China and Korea. It is also reported in Japan, Mongolia, the Russian Far East, and Taiwan. In China, high populations of EAB occur primarily in *Fraxinus chinensis* and *F. rhynchophylla*, usually when those trees are stressed by drought or injury. Other Asian hosts (*F. mandshurica* var. *japonica*, *Ulmus davidiana* var. *japonica, Juglans mandshurica* var. *sieboldiana,* and *Pterocarya rhoifolia)* may be colonized by this or a related species.

In North America EAB has attacked only ash trees. Host preference of EAB or resistance among North American ash species may vary. Green ash (*F. pennsylvanica*) and black ash (*F. nigra*), for example, appear to be highly preferred, while white ash (*F. americana*) and blue ash (*F. quadrangulata*) are less preferred. At this time all species and varieties of native ash in North America appear to be at risk from this pest. Recently EAB was found on white fringetree (*Chionanthus virginicus*); however, its role as a susceptible host or as a secondary host in areas of high EAB densities is not fully understood and continues to be evaluated.

Signs and Symptoms

It is difficult to detect EAB in newly infested trees because they exhibit few, if any, external symptoms. Jagged holes excavated by woodpeckers feeding on late instar or prepupal larvae may be the first sign that a tree is infested (Fig. 6). D-shaped exit holes left by emerging adult beetles may be seen on branches or the trunk, especially on trees with smooth bark (Fig. 5). Bark may split vertically over larval feeding galleries. When the bark is removed from infested trees, the distinct, frass-filled, serpentine larval galleries that etch the outer sapwood and phloem are readily visible (Fig. 4 and Fig. 7). An elliptical area of discolored sapwood, usually a result of secondary infection by fungal pathogens, sometimes surrounds galleries.

Left to right:

Figure 6. Jagged holes left by woodpeckers feeding on larvae.

Figure 7. Ash tree killed by emerald ash borer. Note the serpentine galleries.

As EAB densities build, foliage wilts, branches die, and the tree canopy becomes increasingly thin. Many trees appear to lose about 30 to 50 percent of the canopy after only a few years of infestation. Trees may die after 3 to 4 years of heavy infestation (Fig. 7). Epicormic shoots may arise on the trunk or branches of the tree (Fig. 8), often at the margin of live and dead tissues. Dense root sprouting sometimes occurs after trees die.

Figure 8. Epicormic branching on a heavily infested ash tree.

EAB larvae have developed in branches and trunks ranging from 2.5 to 140 cm (1 to 55 in.) in diameter. Although stressed trees are initially more attractive to EAB than healthy trees are, in many areas all or nearly all ash trees greater than 3 cm (1.2 in.) in diameter have been colonized by this invasive beetle.

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Additional Resources

For the latest information on EAB in your area:

Contact your State Department of Agriculture, State Forester, or Cooperative Extension Office; and visit the following Web sites:

www.emeraldashborer.info
www.hungrypests.com

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State and Private Forestry
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